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No. 17,487/34.

APPLICATION DATED

8th May, 1934.

Applicant (Actual Inventor) ARNOLD NESBITT MACNICOL.
Application and Provisional Specification Accepted, 15th June, 1934.
Complete Specification Accepted, 10th June, 1935.
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Class 12.3.

Drawing attached.

COMPLETE SPECIFICATION.

"Improved method of and apparatus for separating particles of different specific gravities and recovering those desired."

I, ARNOLD NESBITT MACNICOL, of No. 11 Phillip Street, Sydney, in the State of New South Wales and Commonwealth of Australia, Consulting Engineer, hereby declare this invention and the manner in which it is to be performed to be fully described and ascertained in and by the following statement:—

This invention relates to the separation of particles of different specific gravities and recovery of those desired, and has been specially devised in order to provide an improved method of and apparatus whereby the desired particles whether the heavier or lighter may be separated and recovered.

The improved method of separating particles of different specific gravities constituting finely ground material and recovering those desired comprises the discharge of a mixture of material constituted of finely ground particles and a suitable liquid into a rapidly rotating vessel having a plurality of axially spaced and circumferentially arranged and inwardly disposed riffles which may be in any convenient form such as, shoulders, ridges, grooves or channels, but preferably inwardly open recesses so that the heavier particles, such as gold, which attain a higher velocity than lighter particles

during centrifugalization, will reach and lodge in or upon the riffles before the lighter particles, and then removing the lighter particles by discharging washing liquid, generally water, radially or at suitable angle or angles in the direction of the wall and riffles thereof to stir, diffuse and carry such particles from the vessel, and when the construction of the vessel is suitable, allowing the heavier particles to pass from the recesses through the wall of the vessel into a receiver therefor.

The mixture of the material is made of finely ground particles and water as a liquid, but where required and or suitable according to the nature of the particles to be separated and to be recovered, the liquid may be water with its density increased by the addition of suitable substance or substances, such as salt, or natural salt water may be used if readily available, or the liquid may be of a viscous nature, such as oil or glycerine, or of a lighter nature, such as benzine or alcohol, and when the nature of the particles is suitable, substances having a selective affinity for desired particles may be added to the liquid, and when a collecting medium, such as mercury, is applied to the vessel, the liquid may have added thereto cleansing substances, such as acid, alkali, or 30

aponeaceous substances, in order to cleanse particles in the mixture to facilitate or promote their accretion by or amalgamation with the collecting medium, or suitable substance having dissolving effect may be added to the mixture to act upon the particles, and dissolved material may be recovered later from the overflow.

The improved apparatus according to this invention comprises a vessel whose depth or length is preferably greater than its diameter, which is adapted to be rapidly rotated upon its axis, which may be vertical or horizontal, or at any angle therebetween. The wall of the vessel is provided with a plurality of axially spaced and circumferentially arranged inwardly disposed riffls, preferably in the form of inwardly open recesses either formed integral therewith or in replaceable and removable ring or flange into channels provided therefor, and each of the recesses may have when suitable to the heavier particles to be separated according to the nature and presence thereof, an escape orifice through the vessel wall preferably from the deepest position of the recess, so that such particles may pass through the vessel into a receiver provided therefor, and means may be provided for closing or screening and opening or uncovering all the orifices, so that they may be closed and opened or screened and uncovered at suitable stages of the centrifugalization and or separation, and the wall of the vessel between the axially spaced riffls, may be corrugated or fluted or ribbed at any desired or requisite angle or angles to the riffls thereabout, to catch the heavier particles during centrifugalization, and guide them to the riffls and thence to the vessel, either depending thereinto or arranged therewith, and adapted to be rotated or to be stationary, supply pipes one for supply and discharge of the mixture to the vessel, and the other or others for supply and discharge of washing liquid into and through the mixture in the vessel to cause disturbance therein and diffusion of the contained particles, particularly the lighter which may be overlying the heavier particles in the riffls, each pipe having through its wall discharge openings or nozzles at desired peripherally and axially spaced positions and disposed at desired angle or angles in relation to the wall of the vessel and of the riffls thereof, and

desired, the supply connection to the mixture pipe may have therein a regulatable valve or control adapted and arranged to be mechanically operated as desired, in order that the supply of mixture may be intermittent, so that such mixture will be discharged into the vessel intermittently or in pulses from said pipe, thereby to attain a pulsatory effect in the mixture in the vessel to assist in or maintain the diffusion of the particles and thus facilitate their separation.

If desired a series of the vessels may be arranged preferably at different levels, and each be provided with a chute thereabout to receive the overflow therefrom and convey to the next vessel, and from the last into a suitable launder so that after settlement therein the liquid may be withdrawn for further use or to waste, and any remaining particles be recovered.

And in order that the invention and practical applications thereof may be readily understood the same will now be described with reference to the accompanying drawings in which—

Figure 1 is a sectional elevation of the improved apparatus,

Figure 2 is a fragmentary plan of part of the vessel on the line 2-2 in Figure 1,

Figure 3 is a fragmentary perspective of 30 Figure 2,

Figures 4, 5 and 6 are fragmentary vertical sections of modified constructions of the vessel and

Figure 7 is a longitudinal section of a 35 further modified apparatus.

The vessel 10 which is rotatably mounted upon or in suitable bearings such as by item 11, hollow shaft 12 and bearings 13, and adapted to be rotated by suitable means, 40 may have a gear 14 or a pulley on the shaft to receive a belt from suitable motive means, has overflow openings 15 with which may be associated a receiving trough 16 with discharge or direction spout 17, also 45 a drain opening 18 at the bottom into the hollow shaft 12. On or in the inner face of the vessel wall are a plurality of axially spaced and circumferentially arranged riffls 19 and between the so spaced riffls 20 the wall of the vessel is provided with ribs, corrugation or flutings 20. The riffls may be formed as 19 in Figure 1, or 21 in Figure 2, or 22 in Figure 6, or as in Figure 7, but preferably are constituted of 55 open recesses 19 as in Figures 1, 5 and 3.

which are inclinedly reduced from the corner of the trailing side wall 23 and the back of the top wall 24, where they are deepest, to the front edge 26 and the opposite side edge 27 which is the top of the trailing wall 23 of the next recess, and at the deepest position of each there is a small escape orifice 25 through the wall of the vessel. In order that all such orifices may be closed and opened as desired, the outer face of the wall of the vessel is formed with a flat 28 thereon, and a slidable cover ring 29 operable by convenient means such as a arm 30 upon a bar 31 which may be moved by any suitable means, not shown, are provided. When it is desired to screen and uncover said orifices the ring may be provided with holes therethrough to juxtapose with the orifices 25, though they may be larger, and be covered with suitable filtering and or straining material.

To facilitate manufacture of the vessel and or the removal of contents of the recesses 19 some are formed in a separate ring 32 which may be in sections and a channel 33 be formed in the vessel wall to receive said ring 32 which would be provided with a socket or sockets 34 to engage a pin or pins 35 in the channel 33 to assure juxtapositioning of the orifices 25 and orifices 36 through the wall.

Inside the vessel are supply and discharge pipes, one for the mixture and others for washing liquid, which may conveniently be concentric pipes, an inner one 37 and an outer one 38, both adapted to be connected to supply and to be rotated, though, if desired, they may be stationary, the former 37 for connection to mixture supply and 40 having an enlargement or chamber 39 on its inner end with a plurality of peripherally spaced discharge openings disposed at suitable angle or angles, such as vertical narrow slots 40 through the vertical wall 45 and the outer pipe 38 terminating at the chamber 39 and having a plurality of discharge openings, such as narrow axially elongated slots 41 through its wall at peripherally and axially spaced positions. Such openings may be of other desired shape or in place thereof nipples or nozzles may be employed.

When separate pipes are provided for the washing liquid they may be stationary

in perspective of the mixture pipe, at a plurality thereof may be positioned at circumferentially spaced positions in the vessel.

In the modified construction as in Figure 5, about the escape orifices 36 through the wall of the vessel is a discharge retarding trough 42 to retard the discharge from the orifices.

The rifles 21 in the wall of the vessel 10 may be formed as in Figure 4 with an inward projection 43 to provide a flat 44, a slight recess 45 at the outer end of the flat 44 and an inward slope 46 from said recess 45 to the next projection 43; or as in Figure 6 the rifles 22 are formed above 16 outwardly and upwardly spaced or stepped channels in the wall, a plugged drain hole 47 being provided, if required, for convenience in cleaning. The vessel has a drain passage 18 at the bottom into hollow 20 shaft 12, or into a pipe, not shown, about said shaft, for passage of the heavier particles when they are sluiced out at termination of separation. As in Figure 7 the rifles are formed by projections 48 having forward and rearward faces flat.

The vessel as in Figure 7 which is shown as vertically fixed, may be horizontally fixed or at any angle therebetween, and the supply pipes 37 and 38 will be so suitably disposed therein.

In operation the vessel being rotated at regulated speed the mixture is supplied whether by gravity or at desired pressure to the pipe 37 and discharges through the 35 openings 40 in the direction of the wall of the vessel and or the rifles thereof, and owing to centrifugalization the heavier particles reach said wall before lighter particles and so form on the inner radial position 40 or therefrom the lighter particles, or some of them, covering same, then washing liquid which is supplied at desired pressure to pipe 38 is discharged into the mixture bottom of the vessel causing movement therein 46 and separation or diffusion of particles in the mixture, particularly of the lighter particles which are or may be overlying the heavier particles in the rifles, such lighter particles being carried away in the overflow 50 from the vessel through the opening 15 and received in the trough 16 and discharged if they are not required, or when they are desired the overflow is directed into another apparatus for further separation and or 55 treatment to recover any desired particles.

and or metal in solution, or to a launder for settlement and thereafter gathering of such particles.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:

1. Improved method of separating particles of different specific gravities and recovering those desired, consisting in the centrifugalization of a mixture of such particles and liquid discharged into a constantly rotated vessel towards its wall which is adapted to receive and retain the heavier particles, and discharging washing liquid into the mixture in said vessel to cause agitation therein and separation and or diffusion of the lighter particles so that said particles will be carried off in the overflow from said vessel.

2. Improved method of separating particles of different specific gravities and recovering those desired, consisting in discharging a mixture of the particles and liquid towards the wall of a constantly rotated vessel which is adapted to receive and retain the heavier particles, and discharging and diffusing the lighter particles in the mixture by discharging washing liquid into the mixture at desired pressure at any desired angle towards said wall and allowing said lighter particles to be carried off in the overflow from said vessel.

3. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which the mixture is discharged into the vessel intermittently to obtain a pulsatory effect therein.

4. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which the density of the liquid forming the mixture is increased by the addition of suitable substance or substances.

5. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which the liquid forming the mixture is of a viscous nature.

6. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which the liquid forming the mixture is of a light nature, such as benzine or alcohol.

7. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which ingredients having an affinity for some of the particles to be separated are added to the liquid forming the mixture.

8. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which ingredients having a cleansing and or dissolving effect upon particles, or some of them, in the mixture are added to said mixture.

9. Improved method of separating particles of different specific gravities and recovering those desired as in Claims 1 and 2, in which the vessel is first supplied with a collecting medium, such as mercury.

10. Improved method of separating particles of different specific gravities and recovering those desired, substantially as described and explained.

11. Improved apparatus for separating particles of different specific gravities and recovering those desired, comprising a rotatable vessel having a plurality of axially spaced and circumferentially arranged riffler upon the inner face of its wall, and mixture supply and washing liquid supply pipes inside said vessel respectively adapted to discharge mixture and a washing liquid at desired angle or angles towards the wall of said vessel.

12. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claim 11, in which the vessel has ribs, corrugations or flutings or the like between the axially spaced riffler and disposed at an angle or angles leading to said riffler.

13. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claim 11, in which the riffler are in the form of inwardly disposed projections with an upwardly disposed flat or slight recess at the outer end of said flat, and an inward slope from the top of said recess to the next higher projection.

14. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claim 11, in which the riffler are formed above upwardly spaced and outwardly stepped channells.

15. Improved apparatus for separating particles of different specific gravities and

recovering those desired as in Claim 11, in which the rifles are in the form of upwardly or forwardly flat and downwardly or rearwardly sloped projections.

16. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claim 11, in which the rifles are in the form of a plurality of circumferentially divided inwardly open and rearwardly deepened recesses.

17. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claim 11, in which the rifles are in the form of inwardly open recesses in the wall of the vessel and are outwardly deepened to an escape orifice through said wall.

18. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claims 11 and 17, in which means are provided for closing or screening and opening or uncovering the outer ends of the escape orifices.

19. Improved apparatus for separating particles of different specific gravities and recovering those desired as in Claims 11 and 17, in which a discharge retarding trough is formed upon or with the wall of the vessel about the outer ends of the escape orifices.

20. Improved apparatus for separating particles of different specific gravities and recovering those desired, comprising the

combination and arrangement of the integers substantially as described and explained with reference to Figure 1 of the drawings.

21. Improved apparatus for separating particles of different specific gravities and recovering those desired, comprising the combination and arrangement with the other main integers as described, of a vessel having the rifles formed with the wall substantially as described and explained with reference to Figure 4 of the drawings.

22. Improved apparatus for separating particles of different specific gravities and recovering those desired, comprising the combination and arrangement with the other main integers as described, of a vessel having the rifles formed with the wall substantially as described and explained with reference to Figure 5 of the drawings.

23. Improved apparatus for separating particles of different specific gravities and recovering those desired, comprising the combination and arrangement with the other main integers as described, of a vessel having the rifles formed with the wall substantially as described and explained with reference to Figure 6 of the drawings.

Dated this sixth day of March, A.D. 1935.

ARNOLD NEADITT MACNICOL,

By his Patent Attorney,

PERCY NEWELL.

Witness—Graham Newell.



